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1276249

DRAWINGS ATTACHED

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(54) IMPROVEMENTS IN OR RELATING TO PERCUSSION DRILL BITS

(71) We, MISSION MANUFACTURING COMPANY, a corporation organized under the laws of the State of Delaware, one of the United States of America, of 8760 Clay Road, City of Houston, State of Texas, United States of America, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

The invention relates to rock bits for percussion drills which carry cutting elements on a forward end face of the bit.

Normally, rotary cone-type bits are used for deep hole percussion drilling since no fully satisfactory way has been provided for maintaining the size of the hole when solid bits are used for this purpose. However, rotary cone bits do not possess the strength characteristic of solid bits, and, therefore, cannot be subjected to the full potential energy output of modern, downhole percussion tools. On the other hand, with the use of solid bits, rapid wear on the outside diameter of the body results in unacceptable loss of hole gauge long before the face cutters of the bit are worn out. In some case, complete failure of the peripheral cutting elements due to the pinching effect on the outside diameter of the bit makes it necessary to pull the bit early. Furthermore, there is a re-entry problem in the insertion of a new full-sized bit into the undersized hole.

Therefore, the present invention seeks to provide a rock bit which is sufficiently rugged for use with high pressure percussive-type downhole tools and which will effectively maintain the desired hole gauge.

The invention also seeks to provide a percussion-type rock bit which will drill a hole of slightly larger diameter than the maximum diameter of the bit itself so as to reduce bit wear and facilitate reinsertion of a new bit into the hole.

Accordingly, the invention provides a rock bit, for a rotary percussion drill, comprising a generally cylindrical body provided with a forward surface carrying cutting elements, a portion of the forward surface extending around the axis of the bit being at least in part inclined to said axis, the cutting elements on said portion being arranged asymmetrically with respect to said axis to provide, in use, a lateral thrust on the bit body, the bit having further cutting elements for cutting the side wall of the hole being drilled, said further cutting elements projecting laterally from the side of the bit which is driven, in use, towards said side wall by said lateral thrust.

During drilling, the bit is subjected to axial percussive blows developed by a downhole percussion drilling motor and also to rotary indexing action applied through the supporting drill stem and the rotary table. During this drilling action, the asymmetrically disposed cutting elements bear against an inclined portion of the hole bottom so as to produce a lateral component of body movement due to sliding or wedging action. Accordingly, the further cutting elements mounted at the periphery or side of the body are caused to bite laterally into the hole side wall incident to each vertical percussive blow applied to the body, thus, drilling a hole which in diameter is slightly larger than the maximum diameter of the body.

For a better understanding of the invention and to show more clearly how the same may be carried into effect reference will now be made, by way of example, to the accompanying drawings in which:

Figure 1 is a partial axial section through a bit embodying one form of the invention;

Figure 2 is a forward or bottom view of the bit in Figure 1; and

Figures 3 and 4 are views similar to Figure 1 but showing other modifications of the bit.

The bit in Figures 1 and 2 comprises a generally cylindrical body, designated A, having side wall structure B and a forwardly facing bottom surface, generally designated C. Side wall structure B slopes slightly upwardly and inwardly, and has flutes 6, 7 and 8 arranged symmetrically thereabout. Bottom surface C includes an outer annular portion 9 which merges with side wall structure B in a chamfer

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10. Within surface part 9 is a conical, recessed surface portion 11. Spirally traversing annular surface portion 9 are wash grooves 12, 13 and 14 connecting recess 11 with flutes, 6, 7 and 8. Wash passages 15, 16, 17 and 18 connect with a central passage 19 in the bit for conducting bit cooling and lubricating and cuttings-removing fluid, either liquid or gas, to the cutting surface of the bit and thence outwardly through grooves 12, 13 and 14 and upwardly through flutes 6, 7 and 8 and the annulus between the percussion drill, drill collars, and drill stem, as is well-known.

Mounted in and projecting from conical surface portion 11, at one side thereof, that is, symmetrically with respect to surface C and the axis of the bit body, are hardened, button-type cutter inserts 20. Mounted in and projecting forwardly from the part 9 of the cutter surface, which part extends normal to the body axis, are sets of hardened, button-type inserts 21, 22 and 23. Mounted in or adjacent chamfer 10 at the periphery of the cutter surface are hardened inserts 25, 26 and 27 which, preferably, extend both forwardly and sidewardly of the bit body. As shown in Fig. 2, these inclined, gauge-cutting inserts are located predominantly at the same side of the bit as the asymmetrical inserts 20 previously mentioned.

In operation of the bit disclosed in Figs. 1 and 2, body A will be mounted at the bottom or forward end of a drill string with a percussion drill motor inserted therein and drill collars or other weighting means as needed. The drill fluid will then be supplied through the drill string under pressure for operating the percussion motor and cooling and lubricating the bit while washing the cuttings upwardly through the annulus around the drill string. Upon the delivery of each downward percussive blow to body A, the bottom surface portion 30 of the hole will be chipped by cutter inserts 21, 22 and 23. At the same time, a short core or projection 31 will be formed at the center of the hole bottom and, due to inserts 20 and the rotary motion of the bit, ultimately, will assume the conical shape as shown in Fig. 1. Thereafter, asymmetrical insert buttons 20 in the conically recessed portion 11 of the bit forward surface will strike the conical projection 31 at one side only, so that the bit body will receive a lateral component of motion, represented by the arrow 32, as well as a vertical component of motion, represented by the arrow 33. The vertical component of bit motion, acting through inserts 20—23, inclusive, will chip the bottom surface of the hole and, due to the indexing action, ultimately, the entire hole bottom will be evenly cut. At the same time, the lateral component of bit motion will cause gauge inserts 27 to strike the peripheral portion 34 of the hole bottom with an outward as well as downward motion which will extend the hole laterally a greater distance than the radius of the bit body. Thus, wear on side surface B of the body is reduced, while the hole is drilled at a diameter slightly greater than the diameter of the bit to facilitate withdrawal and replacement thereof. The motion of the bit may cause inserts 21, 22 and 23 to strike the hole bottom with a glancing blow which helps in the chipping action. Alternatively, inclined buttons 20 may be positioned so that inserts 21—23 strike the hole bottom only near the end of the bit motion enforced by engagement of buttons 20 with cone 31.

Fig. 3 shows a modification in which the conical recess 11 of Figs. 1 and 2 is replaced by a conical projection 36. Hardened inserts 37 and 40 are provided, respectively, in the annular outer surface portion 38 which is generally normal to the axis of the body, and in peripheral chamfer 39. Inner cutter inserts 41 are mounted in and project from one side only of conical projection 36. In this form, the sideward component of bit motion, upon each percussive blow, will be leftwardly, as indicated by arrow 42, so that the leftward peripheral inserts 40 will serve to maintain the gauge of the hole.

Fig. 4 illustrates still another arrangement of the bit bottom surface, including a flat, central portion 45 which is generally normal to the bit axis and a frusto-conical outer surface part 46. Inserts 47 at the center of the bit cut the central part 48 of the hole bottom. In this form, however, while the cutter inserts in conical surface portion 46 are predominantly at the left side, as at 49, other inserts 50 are disposed oppositely thereto. With this arrangement, the actual cutting effect produced by the more numerous inserts 49 at the left side of the bit will be less than in the case of the less numerous inserts 50 at the opposite side. This is because the force of the percussion blow on each button 49 will be less than the force applied to each button 50. Inserts 49 will tend to slide downwardly along the inclined bottom surface part 51 causing less numerous inserts 50 opposite thereto to cut into inclined bottom surface part 52 while peripheral buttons 53 cut into the side wall of the hole, due to the rightward lateral motion, symbolized by arrow 54.

Thus, it is only necessary that cutter elements located on an inclined part of the forward or bottom surface of the bit be disposed asymmetrically in order to produce a lateral component of bit motion which, acting through the insert buttons located at the periphery of the body, will cause direct lateral cutting action on the side wall of the hole. This has the effect of drilling a hole which is larger in diameter than the bit itself so as to reduce wear on the bit side wall structure while greatly facilitating withdrawal and reinsertion of the bit. The bit body may be of the separate type, with means for attachment to the drill string or percussion tool, or may be formed

integrally with the anvil part of the tool. The particular configuration of the bit as well as the type of cutter elements used also may be varied as will occur to those skilled in the art.

WHAT WE CLAIM IS:—

1. A rock bit, for a rotary percussion drill, comprising a generally cylindrical body provided with a forward surface carrying cutting elements, a portion of the forward surface extending around the axis of the bit being at least in part inclined to said axis, the cutting elements on said portion being arranged asymmetrically with respect to said axis to provide, in use, a lateral thrust on the bit body, the bit having further cutting elements for cutting the side wall of the hole being drilled, said further cutting elements projecting laterally from the side of the bit which is driven, in use, toward said side wall by said lateral thrust.

2. A rock bit as claimed in Claim 1 in which said portion is concentric with the bit axis.

3. A rock bit as claimed in Claim 1 or 2 in which said portion is at the lateral periphery of the forward surface.

4. A rock bit as claimed in Claim 3 in which the forward end of the bit body is generally frusto-conical.

5. A rock bit as claimed in Claim 1 in which said portion is positioned substantially centrally of the forward surface and is generally conical about the bit axis.

6. A rock bit as claimed in Claim 5 in which the portion extends axially inwardly.

7. A rock bit as claimed in Claim 5 in which the portion extends axially outwardly.

8. A rock bit as claimed in any one of the preceding claims in which a further portion of the forward surface extends normally to the bit axis and carries cutting elements projecting forwardly of the surface.

9. A rock bit as claimed in any preceding claim in which said further cutting elements are carried on the boundary between the side and end faces of the bit and project laterally and forwardly therefrom.

10. A rock bit as claimed in any one of the preceding claims in which the cutting elements comprise discrete, hardened inserts.

11. A rock bit, for a percussion drill, comprising a generally cylindrical body having a forwardly facing surface which includes a generally conical portion and a second portion disposed normally to the bit axis, wash passages in the body opening into the forward surface for lubricating the bit and removing cuttings, first cutting elements mounted in said conical surface portion asymmetrically with respect to the bit axis for causing lateral motion of the body when subjected to axial percussive blows in drilling, bottom cutting elements mounted in and projecting forwardly from the second surface portion, and cutting elements mounted at the intersection of the side walls and the forward surface at the side to which the bit is laterally moved, in use, to determine the gauge of the hole.

12. A rock bit, for a percussion drill, substantially as herein described with reference to and as shown in the accompanying drawings.

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2 SHEETS *This drawing is a reproduction of the Original on a reduced scale*

Sheet 1

Fig. 1

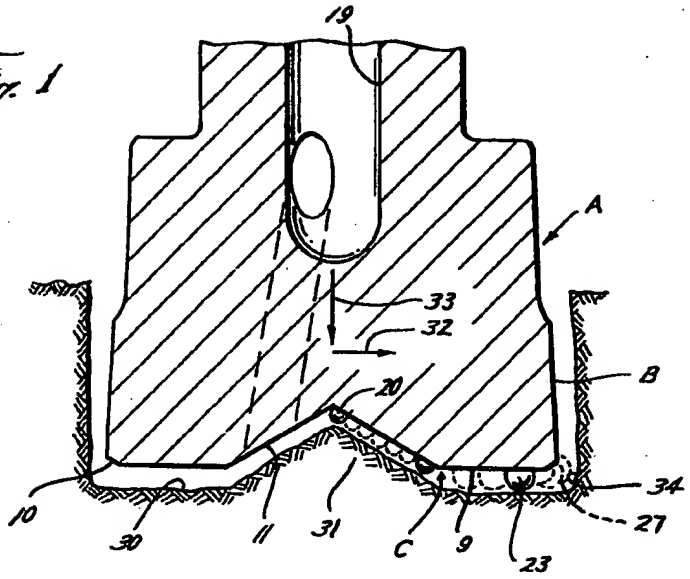
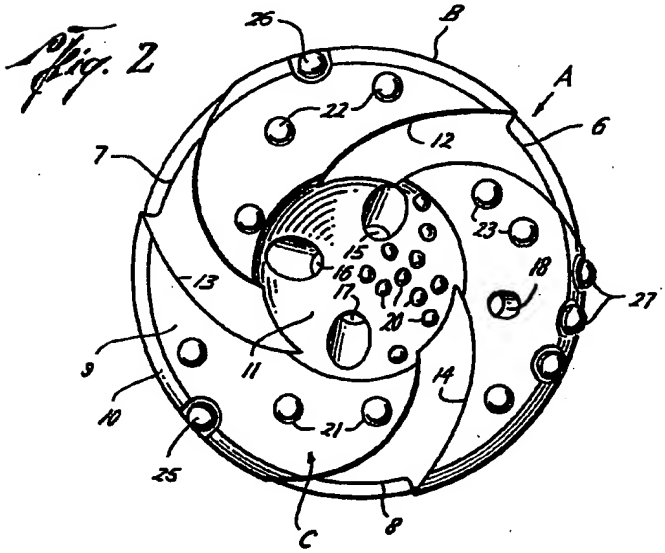


Fig. 2



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Sheet 2

Fig. 3

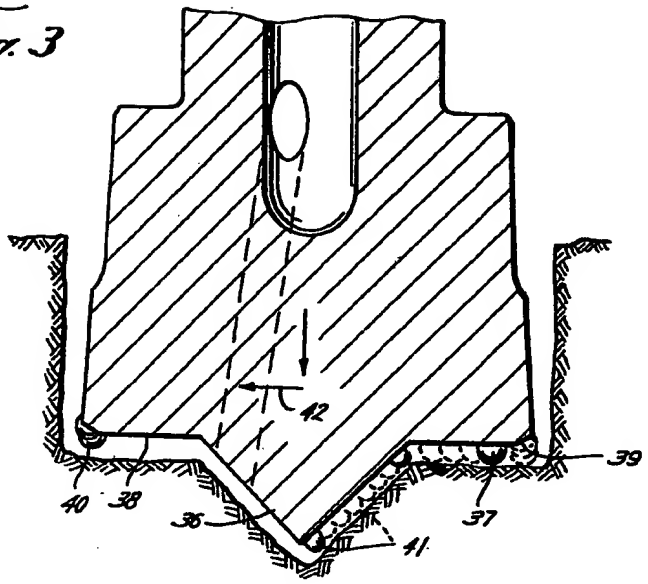

Fig. 4